EazyPV - Solar tester

Manual

Solar

Mors Smitt B.V.
Utrecht

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This user manual is compiled with all possible care, but Mors Smitt B.V. cannot accept any responsibility for possible errors in this user manual or any consequences resulting from that.

Preface

This manual describes the EazyPV. The information in this manual is important for proper and safe functioning of the equipment. If you are not familiar with operating this equipment, read this user manual from the beginning to the end thoroughly. After that you can use this manual for reference. You can find the information rapidly using the table of contents.

In this user manual, the following marking conventions are used to focus attention on certain subjects or actions.

Tip:
Gives you suggestions and advice to perform certain tasks easier or handier.

Attention:
A remark with additional information; draws your attention to possible problems.

Caution:
The EazyPV may be damaged, if you do not carefully execute the procedures.

Caution:
The EazyPV may be damaged, if you do not carefully execute the procedures.

Terms, abbreviations and indications

In this manual the following abbreviations are used:

- User manual or manual: terms for the description of this document
- Device, measuring device, tester are used for the EazyPV
- Texts on the display are placed between quotation marks (e.g. 'VDC')
- Buttons and keys that need to be operated are displayed with the image of the key

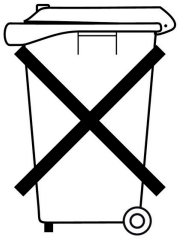
Warning pictograms on the tester

On the tester a number of pictograms are attached meant to warn the user for remaining risks that may be presented when using the instrument, despite its safe design.

Pictogram	Description	Location on tester
	Warning: General sign for danger. Read the instructions carefully before use.	At the backside of the tester, on the instruction label.
	Warning: Danger for direct contact with live parts.	At the backside of the tester.
CE	**CE-mark:** Declares the conformity with the European directives.	The CE-mark is located on the backside of the tester

Tabel 1: Pictograms on the tester

Disposal / removal of device



This device has been designed and produced with high quality material and components that can be recycled.

If this symbol is applied on a product it is complied with the European Directive 2002/96/EC.

Inform how collecting of products with this logo is regulated in your area. Remove this device only following these regulations and not with the general waste. Correct disposal will contribute to a better environment.

Warranty

Mors Smitt B.V. guaranties the tester for a period of 24 months. The period of warranty will be effective at the day of delivery. The warranty clauses and the stipulations regarding liability in terms of delivery are registered in the conditions of FME.

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1. General safety regulations

Warning danger:
Read, before you perform any action in connection with the tester, this user manual carefully. Mors Smitt B.V. is not liable for injuries, (financial) damage and excessive wear resulting from incorrectly performed maintenance, incorrect use of or modifications to the tester.

Attention:
Under certain circumstances, in almost every electronic memory data can be lost or changed. Therefore Mors Smitt B.V. accepts no financial responsibility for losses or claims by lost or otherwise unusable information resulting from abuse, misuse, failure, neglect of the user manual and procedures or other related causes.

Attention:
The EazyPV red and black 4 mm test terminals may be used to make measurements on circuits rated up to CAT III 300 VAC/DC with reference to earth. Do not connect the EazyPV to voltages which may exceed this rating.

Attention:
The PV-testterminals maximum rating: 1000 VDC open circuit voltage, 10 A short circuit current. Do not exceed this rating. The DC supply must be isolated from earth during testing.

Attention:
High voltages are present at the probe tips of the EazyPV during insulation resistance measurement. Always hold test probes behind the hand guards.

Attention:
Check the EazyPV and all associated cables and leads before operating the equipment. Do not use if there are signs of damage. Only use the test leads supplied with the EazyPV.

Attention:
Do not touch any exposed metal parts of the PV-installation during testing.

Attention:
Always ensure that the circuit under test is electrically isolated from the mains supply before attempting an earth resistance measurement.

Attention:
Do not leave the EazyPV permanently connected to a PV-installation. Always disconnect all test leads immediately after use.

Warning danger:
It is not allowed to remove, to skirt or to tide over the enclosure or safeties of the tester, during operation.

Warning danger:
It is forbidden to place and/or to use the EazyPV in a room where there is a risk of explosion.

Attention:
If the tester is used by a third party, you being the owner are responsible, unless otherwise specified.

Attention:
Mors Smitt B.V. reserves the right to, without prior notice, update the software in the EazyPV, which is returned for either reparation or other reasons.

Warning danger:
Repair can only be done by Mors Smitt B.V.

Warning danger:
It's forbidden to execute measurements if strong electrostatic or electromagnetic fields are present.

Tip:
Contact Mors Smitt B.V. if you require information concerning training regarding the EazyPV tester.
Tel.: +31 (0)30 – 2881311 (general) www.nieaf-smitt.com

2 General

The Solar Installation EazyPV is a hand held, battery powered, multi-function solar photovoltaic installation test instrument capable of performing all of the electrical tests required by IEC 62446.

The following tests can be performed with the EazyPV:
- Earth continuity @ 200 mA
- Open circuit module, string or array voltage
- Voltage polarity
- Short circuit module, string or array current
- Insulation resistance at 250 V, 500 V and 1000 V
- AC or DC operating current

2.1 Intended use

The EazyPV is testing according IEC 62446 in order to determine the electrical safety of Photovoltaic systems.

Attention:
The EazyPV is a tool to determine the electrical safety of Photovoltaic systems. Before any electrical test are performed, a visual inspection is required.

2.2 Target group

The target group of people for whom the tester and this user manual are applicable are technical qualified persons.

Technical qualified persons are persons who:
- have got a certain level of technical knowledge gained by education/training
- have got certain skills required to operate the tester
- are familiar with the applied technology in the instrument and are aware of the possible dangers and risks

2.3 Environmental conditions

- The EazyPV has been designed to perform tests and measurements in a dry environment
- Maximum barometric elevation for making measurements is 2000 m
- Overvoltage category IEC 60664/IEC 61010, 300 V Category III (red and black 4 mm terminals only)
- Pollution degree 2 according IEC 61010-1
- Protective system IP51 according IEC 60529
- Electromagnetic compatibility (EMC) interference immunity and emitted interference conforming IEC 61326-1
- Operating temperature range of 0 °C...+40 °C, without moisture condensation
- Storage temperature range -25 °C...+65 °C (relative humidity up to 90%), the batteries should be taken out

3 Composition of the device

The following items are included:

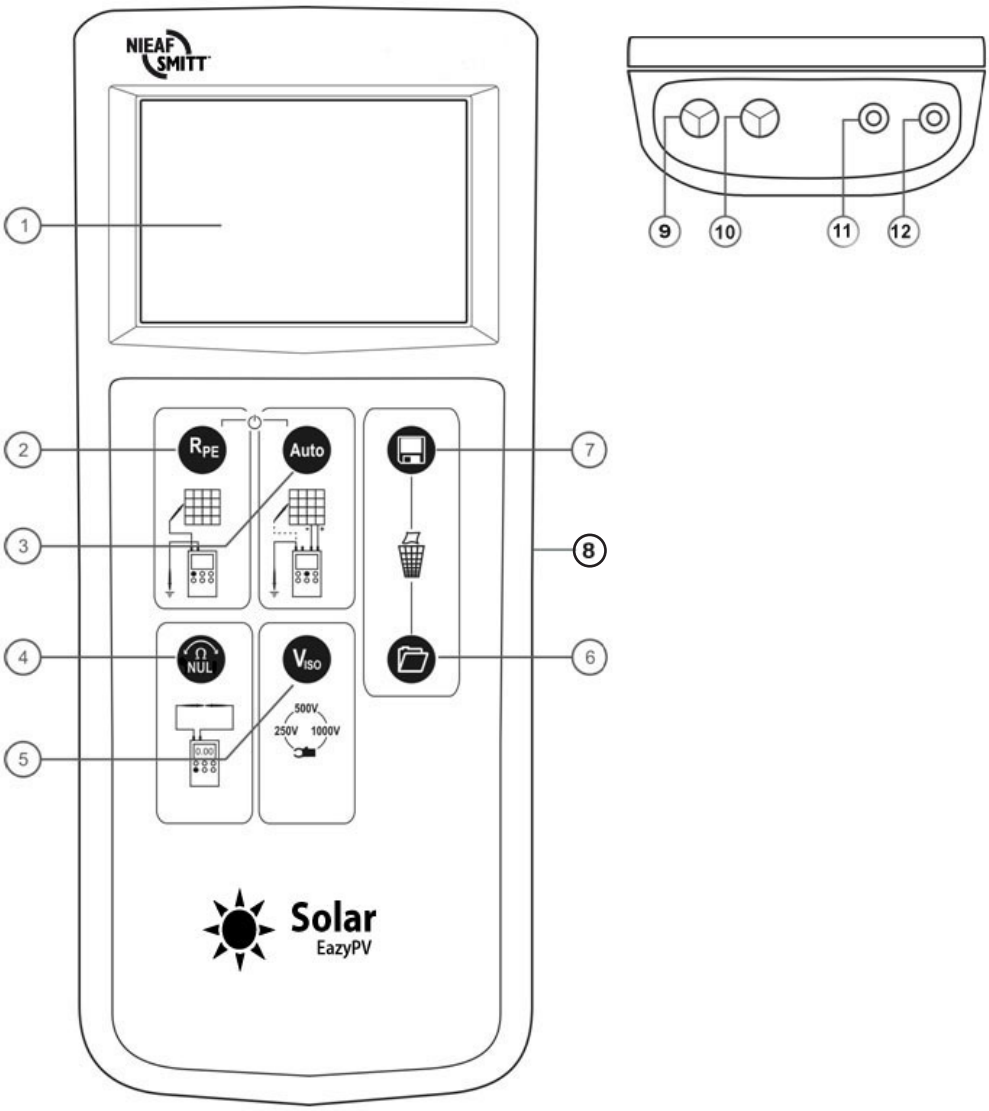
1. EazyPV
2. 2x testleads 1.2 m (red/black)
3. 2x MC4 cables
4. 2x Sunclix cables
5. Quickstart manual
6. 6x MN1500 (AA) 1.5 V batteries
7. Carrying bag
8. Support CD (software, full manual)
9. USB-cable (A-microB)
10. 2x alligatorclamps

For more specifications and extra accessories check appendix 2 and www.nieaf-smitt.com

4 Unit description

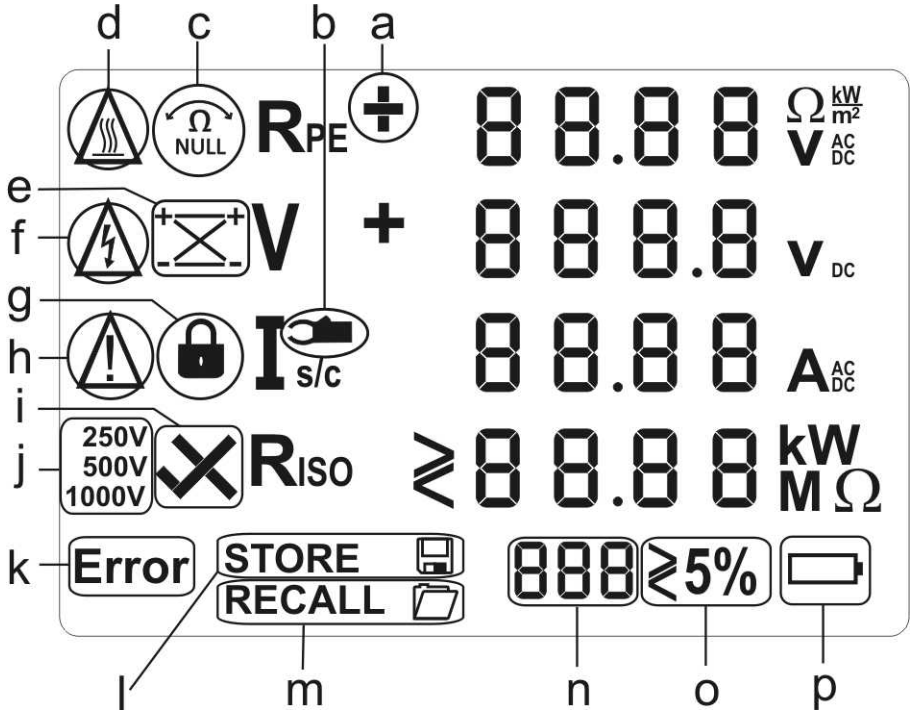
4.1 Operating means

4.1.1 Frontpanel



1. LCD display
2. Rpe test key
3. Auto test sequence key
4. Test lead resistance null key
5. Insulation test voltage select key
6. Memory recall key
7. Memory store key
8. USB-connection
9. +ve PV test lead input (red)
10. –ve PV test lead input (black)
11. +ve 4 mm test lead input (black)
12. –ve 4 mm test lead input (red)

4.1.2 Display



a. Rpe voltage polarity. For AC voltages alternating + and – is shown
b. Current clamp measurement active
c. Rpe Null offset - indicates that test lead resistance offset is active
d. Caution – hot surface. If this icon appears, the EazyPV must be disconnected immediately from the PV system until the icon is no longer shown on the LCD
e. Solar module polarity indicator – indicates the polarity of the DC voltage applied to the PV test terminals e.g. correct or reversed
f. Caution – hazardous voltage detected
g. Rpe test lock – active when continuous Rpe measurement has been enabled
h. Caution – refer to operating instruction. When this icon is active, the operating instructions must be followed to avoid risk of danger
i. Riso PASS/FAIL – indicates whether the measured insulation resistance is above or below the factory set acceptable value
j. Insulation Test Voltage selection – indicates the test voltage selected for insulation resistance measurements
k. Error – Refer to the specific error codes for further details
l. STORE – LCD data is being stored in the onboard memory
m. RECALL – the data shown on the LCD has been recalled from the onboard memory
n. User Memory display – indicates the memory location of the results stored or recalled on the LCD
o. Voltage/current variation – indicates in the measured voltage and current values deviate by more than or less than 5%
p. Battery status icon

4.2 Power on/off of the EazyPV

To switch the EazyPV on, press the Rpe and Auto buttons simultaneously.

Attention:
Press and hold the buttons a few seconds to turn the tester on/off

4.3 Battery condition

The EazyPV automatically performs a battery condition check whilst idle and during measurements. When the battery level is low, the battery symbol icon will appear on the display. The EazyPV will continue to function, however the batteries should be replaced.

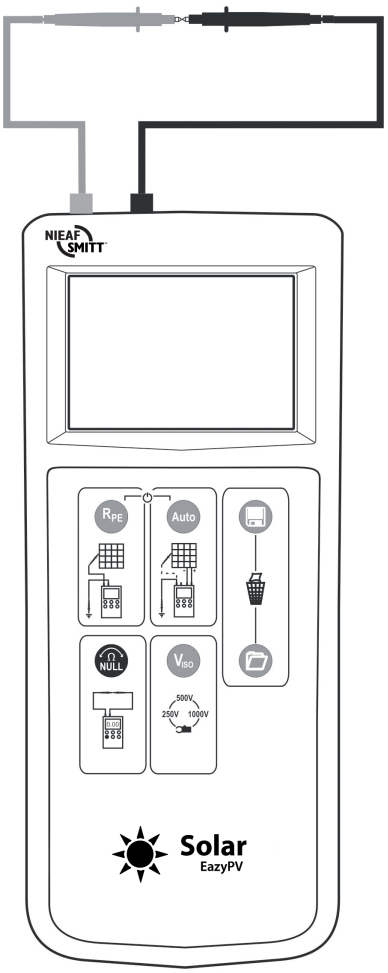
Tip:
When the battery symbol icon is flashing all tests will be inhibited and the batteries immediately must be replaced as described in section 7.3.

5. EazyPV tests

5.1 Protective earth resistance measurement (Rpe)

5.1.1 Test lead resistance null

The EazyPV can automatically compensate for the resistance of the test leads as follows:

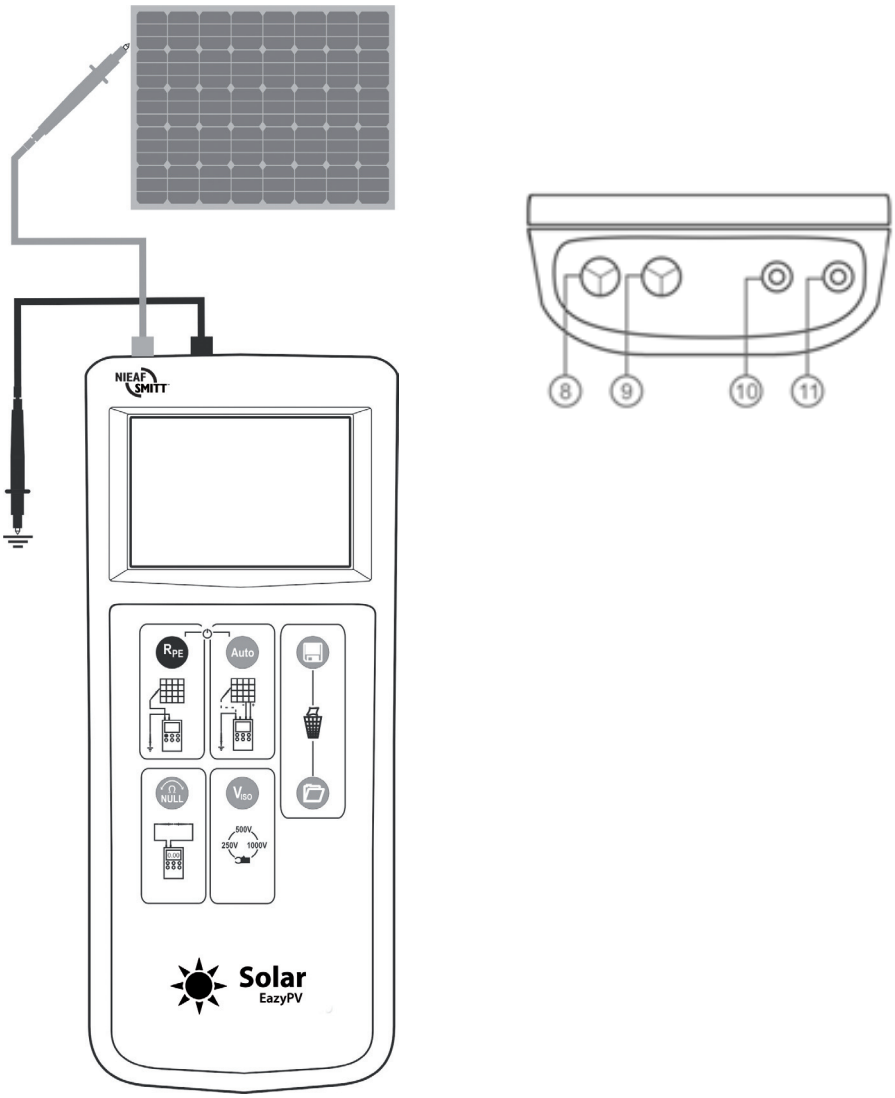


1. Hold the tips of the test probes firmly together as shown, to ensure a good electrical connection
2. Press and hold the 'Null' key
3. The measured resistance of the test leads is shown in the primary display until a beep is heard
4. The Rpe display will now 0.00 and the Null icon is illuminated

Attention:
For ease of use, the EazyPV will store the lead compensation when switched off and recall this value when next switched on. The stored value is only applicable to the test leads used when the compensation measurement was made. If the test leads are replaced the Rpe null function should be repeated using the replacement test leads.

Attention:
A maximum test lead resistance of 10 Ω ohms can be taken into account. If the test lead resistance is greater than 10 Ω an error beep will indicate that the lead zero function has failed.

5.1.2 Resistance measurement



To make a single measurement:

1. Connect the red and black test leads as shown
2. Press the Rpe key R_{PE}
3. The resistance between the test probes is displayed

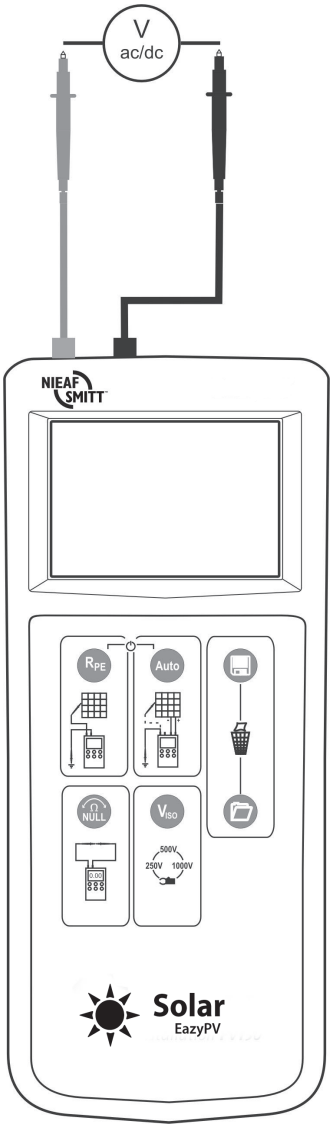
To make a continuous measurement:

1. Connect the red and black test leads as shown
2. Press and hold the Rpe key R_{PE} until the lock icon appears on the LCD
3. The resistance between the test probes is displayed
4. Press the Rpe key R_{PE} to terminate the continuous measurement mode

Attention:
Always ensure the circuit under test is electrically isolated.

Attention:
If the testprobes are connected to a voltage > 5 V, the measured voltage will be displayed on the LCD. If the voltage exceeds 30 V, the RPe measurement function is inhibited

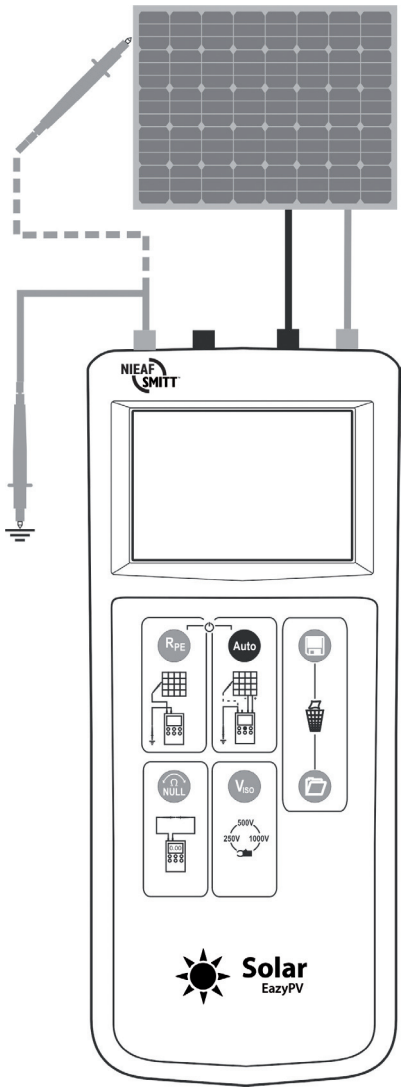
5.2 Voltage measurement



1. Connect the red and black test probes to a voltage source
2. The EazyPV will automatically measure the voltage between the probes
3. The polarity of the voltage is shown using the icon next to the Rpe icon (if the measured voltage is AC, alternating + and – is shown)

Tip:
When the measured voltage exceeds the 30 V limit, the voltage icon ⚠ is shown

5.3 Auto sequence measurement



1. Connect the EazyPV to the PV-module as shown, using the supplied test lead adaptors
2. The red test probe should be connected to earth. Where the structure/frame is bonded to earth, the earth connection maybe to any suitable earth or to the array frame
3. Where the array frame is not bonded to earth, a commissioning engineer may choose to do two tests:
   a. Between array cables and earth
   b. Between array cables and frame
4. The EazyPV will automatically detect any DC-voltage connected to the PV-test socket inputs 8 and 9 and display the measured voltage
5. If the PV-voltage polarity is reversed, the polarity indicator will flash a cross next to the voltage icon
6. If the incoming voltage is >30 v then the shock hazard icon will flash
7. Use the Viso button (Viso) to select either the 250 V, 500 V or 1000 V insulation test voltage

8. Press the auto button Auto and the EazyPV will automatically perform the following tests:
   - Open circuit voltage
   - Short circuit current
   - Insulation resistance
9. The measurement results will remain on the LCD for 20 seconds or until a key is pressed
10. A tick or cross will be displayed next to the insulation resistance measurement indicating whether the result is above or below the threshold values shown.

Viso	Limit
250 V	0.5 MΩ
500 V	1.0 MΩ
1000 V	1.0 MΩ

Table 1

Attention:
Always ensure that the circuit under test is electrically isolated from the mains supply.

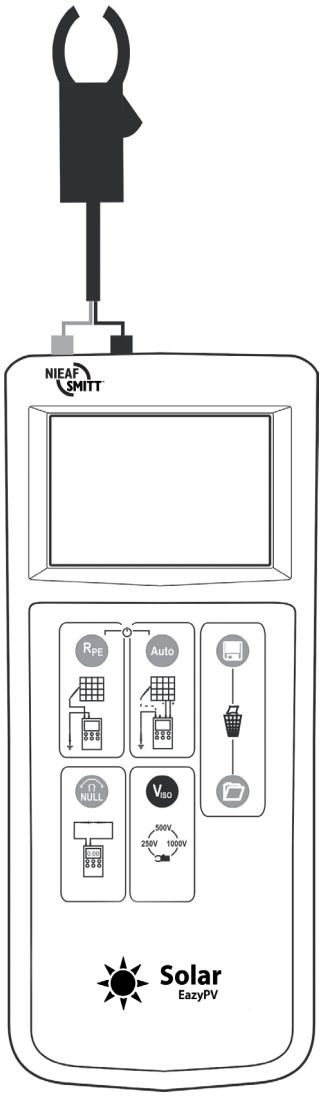
Tip:
Due to the high input impedance of the red 4 mm test terminal, voltage caused by leakage currents may be detected on the prior to starting a test.

Tip:
During the insulation test, the EazyPV applies a short circuit across the PV-string. The insulation test voltage is then applied between the red 4 mm test lead and the two PV-testterminals.

Tip:
If the DC-voltage polarity is incorrect or the voltage is < 5 V or >1000 V the Autotest will be inhibited until the problem is corrected.

5.4 Operating current

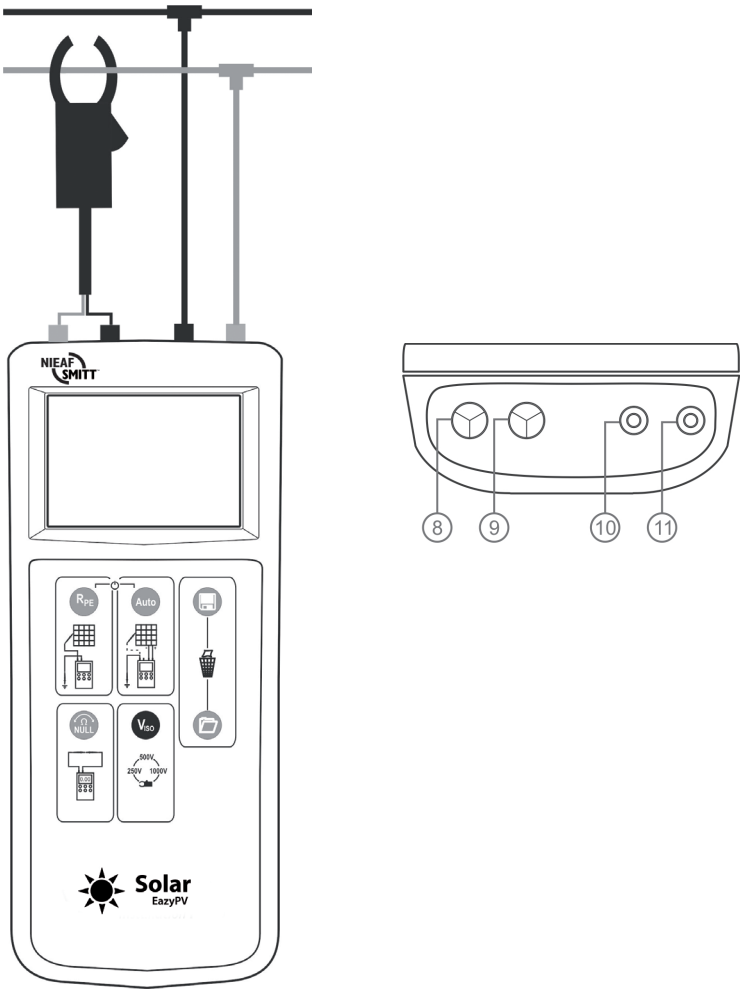
The EazyPV can be used to measure the DC operating current of a solar PV-installation as shown.



1. Disconnect all cables from the PV test inputs (connection 8 & 9 in figure 2)
2. Connect the current clamp to the red – black 4 mm probe inputs.
3. Move the current clamp switch to the 40 A position
4. Zero current clamp according the manual of the clamp
5. Place the clamp around the DC-cable of the solar installation
6. Press the Viso button (Viso) until the clamp icon appears on the LCD
7. The measured current is shown on the LCD next to the clamp icon

5.5 Operating power

The EazyPV can be used to measure the DC operating power of a solar PV installation as shown.



1. Disconnect all cables from the PV test inputs (8 & 9 in figure 2)
2. Connect the current clamp to the red – black 4 mm probe inputs
3. Move the current clamp switch to the 40 A position
4. Zero current clamp according the manual of the clamp
5. Place the clamp around the DC-cable of the solar installation
6. Press the Viso button V_{ISO} until the clamp icon appears on the LCD
7. The measured DC-current is shown on the LCD next to the clamp icon
8. Connect the PV-voltage to the PV inputs. 'T' or 'Y' test adaptors are required if the DC-power is to be measured whilst the PV system is operational
9. The DC-voltage, current and power will be displayed

Tip:
The autobutton is disabled whilst the DC power measurement is in use. Under no circumstances should and Auto test sequence be attempted whilst the EazyPV is connected to the inverter DC inputs as this may result in damage to the instrument.

6. Other functionalities

6.1 Results

6.1.1 Memory store

The EazyPV can store up to 200 complete sets of measurements. Press memory store button to store all measured values on the display.

If there is sufficient memory space to store a set of readings, then the store icon will appear and the reading will be stored in the next available memory location. If there is insufficient memory space then the buzzer will sound. If there are no valid readings on the display then nothing will be stored.

6.1.2 Memory recall

Each press of the recall button will increment the user memory location indicator and display the measured values stored in that memory location. The location number is shown on the bottom of the LCD-display. After the first press of recall , the store button can be used to decrement the user memory location indicator to recall previous memory location. Press and hold the recall button to download data to a PC via the USB-port.

6.1.3 Download results

Connect the tester to the PC using the USB-connection in order to download the measuring results (via the PV Link software). Start the download on the PV link software and press and hold the recall button until the download starts.

5% variation warning

If the recall data has Voc or Isc reading, then the average of all the stored readings is calculated. If the current recalled reading is more than 5% different from the average, then the 5% warning icon will flash.

Average value

Keep pressing the until the location number is 0. The display now shows the average Voc and Isc. of all stored results.

6.1.4 Delete results

Press the store and recall buttons together to clear all the user memory locations.

Tip:
When clearing the memory of the EazyPV all results will be deleted from the internal memory.

6.2 Auto shutdown

After 1 minute of being idle the EazyPV will turn itself off in order to conserve battery power. This auto shutdown period can be extended as follows:

1. Press the 'NULL' key whilst switching on the EazyPV
2. - on the first line the messag 'OFF' will show in the display
   - on the second line the turn-off time
3. Hold the 'NULL' key and press the viso key to adjust the turn-off time
4. The maximum increment time is 10 minutes

Tip:
When displaying DC operating power, the auto shutdown function is deactivated whilst DC-voltage or -current are detected. This will allow extended time for monitoring DC-power.

6.3 Communication with IRM100 (Irradiancemeter)

To link the measured values of the IRM100, the EazyPV can communicate with the IRM100 via a wireless connection. Check the manual of the IRM100 for extra information about wireless communication between the EazyPV and IRM100.

6.4 Error Messages

Under certain conditions, the EazyPV may indicate an error message:

Error message	Remedy
FUSE	The internal fuse has blown. Refer to section 7.4 in the operating instructions for details on how to replace the fuse.
HOt	The electronics within the EazyPV have reached the maximum safe temperature. This can occur after repeated short circuit current measurements at high current levels. Allow the unit to cool down before further use.
H ,SC	The DC short circuit current has exceeded the maximum rated value of 10 A. The measurement sequence has been aborted.
CAL	The EazyPV is not correctly calibrated. Return the unit to an authorised service agent.
Er 1,2	Return the unit to an authorised service agent.
HOtF	Return the unit to an authorised service agent.
FEt	Return the unit to an authorised service agent.
rL 1,2,3 or 4	Return the unit to an authorised service agent.

7. Maintenance

7.1 Calibration and repair

Caution:
Repairs may only be executed by Mors Smitt B.V.

Caution:
Don't replace parts except the batteries and fuse yourself

Attention:
It is advisable to calibrate the tester periodically.

For reparation and calibration contact Mors Smitt B.V.

Tel. +31 (0)30 288 13 11 or www.nieaf-smitt.com

7.2 Cleaning the EazyPV

Use a soft cloth soaked in water, and let the tester dry before usage after cleaning.

Warning for danger:
Always ensure that the circuit under test is electrically isolated from the mains supply.

7.3 Replacing the batteries

1. Power the unit off
2. Disconnect all the test leads from the unit
3. Position the EazyPV face down and release the captive screw in the battery compartment cover.
4. Remove the battery compartment cover
5. Replace batteries from the compartment
6. Relocate the battery cover over the battery compartment and fasten in position with the battery cover captive screw.

Warning for danger:
Before opening the EazyPV ensure that it is disconnected from all voltage! Electric shock danger!

7.4 Replacing the fuse

1. Power the unit off
2. Disconnect all the test leads from the unit
3. Position the EazyPV face down and release the captive screw in the battery compartment cover
4. Remove the battery compartment cover
5. Lift one end of the fuse out of the fuse holder with the help of a flat bladed screwdriver
6. Lift the defective fuse completely out of the fuse holder and insert a new fuse as described and specified by the text on the battery compartment cover
7. Relocate the battery cover over the battery compartment and fasten in position with the battery cover captive screw

Warning for danger:
Before opening the EazyPV ensure that it is disconnected from all voltage! Electric shock danger!

Tip:
All replacement fuse types are specified for ratings and size on the battery compartment cover on the back of the EazyPV

Appendix1 Declaration of conformity

Declariation fo conformity of the product with relevant directives and standards.

EU-DECLARATION OF CONFORMITY

Product: EazyPV

Identification of the tester:

Brand name: Nieaf-Smitt
Model: EazyPV

Mors Smitt declares that the EazyPV operates within specification when used under the conditions in the following directives:

Directive: 2004/108/EG
Directive: 2006/95/EC

and the following standards:

IEC 61010-1:2010
Safety requirements for electrical equipment for measurement, control and laboratory use.
Part 1: General requirements

IEC 61010-2-030:2010
Safety requirements for electrical equipment for measurement, control and laboratory use.
Part 2-030: Particular requirements for testing and measuring circuits

IEC 61010-031:2002+A1: 2008
Safety requirements for electrical equipment for measurement, control and laboratory use.
Safety requirements for hand-held probe assemblies for electrical measurement and test.

IEC 62446: 2010
Grid connected PV-systems - Minimum requirements for system documentation, commissioning tests and inspection

IEC 61557-1,2,4:2007 & 10:2001
Electrical safety in low voltage distribution systems up to 1000 VAC and 1500 VDC - Equipment for testing, measuring or monitoring of protective measures.

IEC 61326:2006
Electircal equipment for measurement, control and laboratory user - EMC requirements.

All tests are performed in a traceable setup.

Date Autorised person

Appendix 2 Electrical specifications

Open circuit voltage measurement (PV-terminals)	
Display range	0.0 VDC – 1000 VDC
Measuring range	5.0 VDC – 1000 VDC
Resolution	0.1 VDC
Accuracy	±(0.5% + 2 digits)
Short circuit current measurement	
Display range	0.00 ADC - 9.99 ADC
Measuring range	0.50 ADC - 9.99 ADC
Resolution	0.01 ADC
Accuracy	±(1% + 2 digits)
Earth continuity	
Test voltage open circuit	>4V
Test current into 2 Ω	>200 mA
Display range	0.00 Ω - 199 Ω
Measuring range (EN 61557-4)	0.05 Ω -199 Ω
Resolution	0.01 Ω maximum
Accuracy	±(2% + 2 digits)
No. of repeat tests as per IEC61557-4	Approx 4000
Insulation resistance	
Test voltage specification	-0% +20% (open circuit)
Test voltage @ 1 mA	>1 mA into UN x (1000 Ω/V)
Test current short circuit	<2 mA
Display range	0.05 MΩ - 199 MΩ
Measuring range (EN 61557-2)	0.20 MΩ - 199 MΩ
Resolution	0.01 MΩ maximum
Accuracy	0.05 MΩ - 100 MΩ ±(5% + 5 digits) 101 MΩ - 199 MΩ ±(10% + 5 digits)
No. of repeat tests as per IEC61557-2	Approx 3000
Rpe voltage measurement (4 mm terminals)	
Display range	30 V – 440 V
Voltage measuring range	30 V – 440 VDC 30 V – 440 VAC 50-60 Hz
Resolution	1 V
Accuracy	±(5% + 2 digits)
Operating current (via AC/DC current clamp)	
Display range	0.1 A - 40.0 A
Current measuring range	0.1 A - 40.0 ADC 0.1 A - 40.0 AAC 50-60Hz
Resolution	0.1 A
Accuracy	±(5 % + 2 digits)
Power measurement (DC only)	
Display range	0.0 kW... 40.0 kW
Current measuring range	0.1 kW... 40.0 kW
Resolution	0.1 kW
Accuracy	±(5% + 2 digit)

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